

Are All WR Stars Binaries?

From spectroscopic observations of bright WR stars it is obvious that the great majority are binaries; one of the components a WR star, the other a normal early-type star. Recently, there has appeared some theoretical work on close binaries which shows that such a pair can undergo a so-called WR stage once or twice during the evolution of the binary. It is seen that the non-WR component can have a wide range in luminosity, from a faint neutron star to a bright O star. This may imply that a binary system always is

responsible for the WR phenomenon, and it is only when the secondary component is bright enough that we have been able to detect its binary nature. Thus, all WR stars might actually be binaries, and in each individual case we have to estimate the influence in luminosity from the companion. This is the main difficulty in the work with WR star absolute magnitudes, and to solve it requires a considerable amount of spectroscopy.

We expect to begin to publish the results of our observations at ESO early in 1978. They were carried out in February 1975 and August 1977.

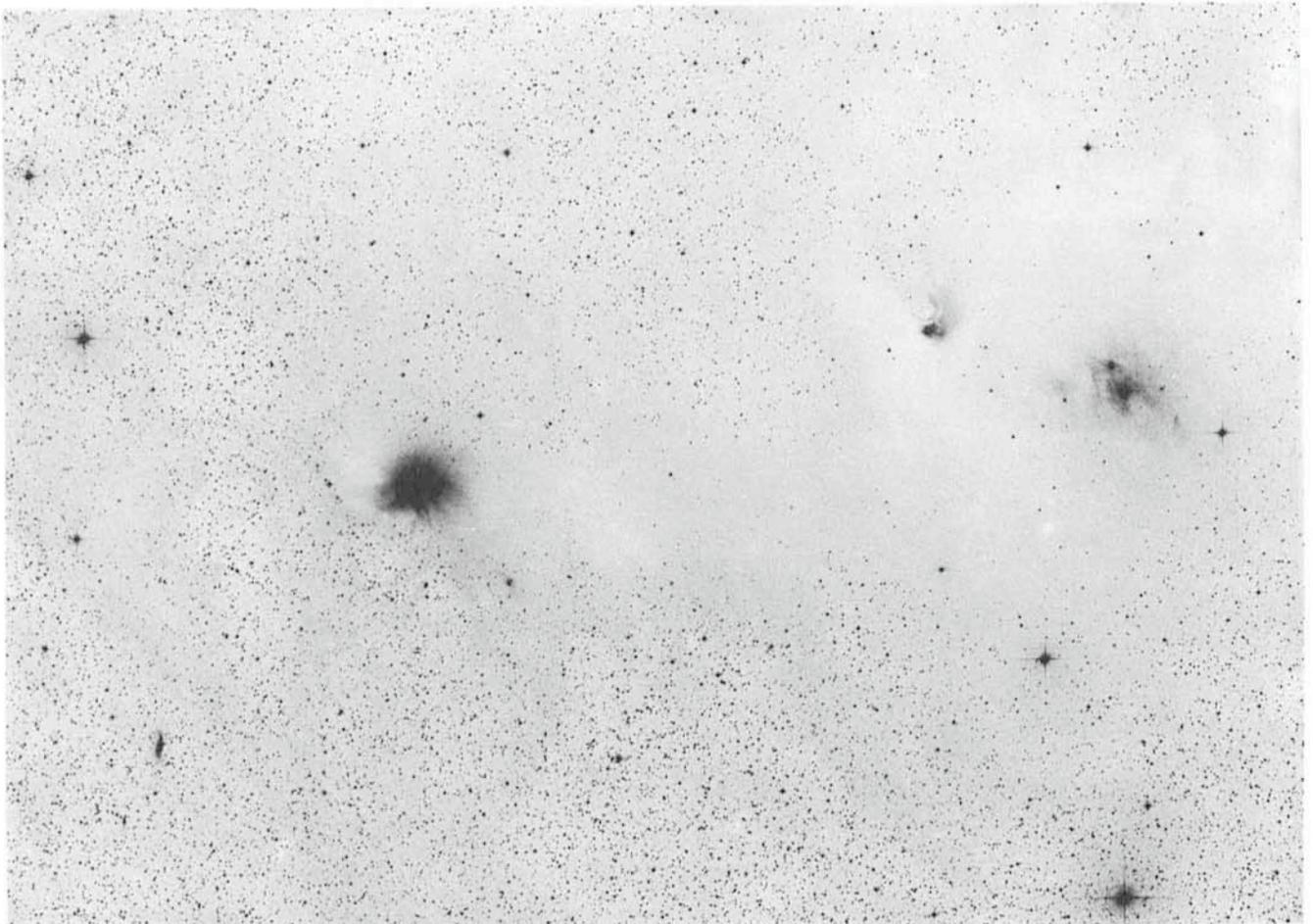
Where Stars are Born

Dr. Claes Bernes of the Stockholm Observatory has compiled a new catalogue of bright nebulosities in dense dust clouds. He found 160 such objects when searching on the Palomar and ESO (B) atlases. Many of these objects are stellar birth-centres and they will soon be studied by radio and infrared observations. Dr. Bernes reports:

If you consult the Palomar Sky Survey or another sky atlas to check the optical appearance of some celestial region that infrared and radio observations have shown to contain newly-formed stars or even stars being formed now (like NGC 1333 or R CrA complex), you often find a nebulous patch situated in a dark cloud. Contrarily, the existence of a bright nebula in a dark cloud has in many cases attracted

the attention of radio and infrared astronomers. It is also clear, after more systematic investigations, that regions with these optical characteristics form a quite well-defined class of objects. Evidently, they may serve as useful indicators of recent and/or still-active star formation.

With this in mind I decided to survey available photographic sky atlases and compile a catalogue of bright nebulo-



The cloud region at $\alpha = 1^{\text{h}} 08^{\text{m}}$, $\delta = -77^{\circ}$, reproduced from field No. 038 of the ESO/SRC atlas. It contains three reflection nebulae (catalogue entries 142-144).

sities in opaque dust clouds. The Palomar Sky Survey and the Whiteoak extension cover the sky north of declination -46° . When I worked on this task during the summer of 1976, the ESO (B) "quick blue" survey of the southern sky was near completion and enabled me to extend the search to more southern areas. Most of the ESO plates were available at the Uppsala Observatory, where the ESO/Uppsala galaxy survey was well under way, and I checked many of the remaining plates during a short visit to ESO/Geneva. At this time, only a small area around the celestial south pole was not yet covered by the ESO survey, which meant that I was able to examine about 99 per cent of the whole sky.

In all, I found 160 bright nebulosities in 80 different dark clouds and cloud regions with a Lynds opacity class of at least 4. Most of these bright objects are reflection nebulae, but the catalogue also contains quite a few Herbig-Haro objects (stars being born by contraction in interstellar dust) and emission nebulae that are clearly embedded in or otherwise physically connected to a dark cloud.

Since most of these regions are relatively nearby and at least to some extent optically resolved, it should in general not be too difficult to get an idea of their structure. Moreover, since many of them are seen well away from the galactic equator (galactic latitudes in excess of 15° are quite common), confusion with more distant galactic infrared or radio sources should not be a major problem.

The part of the sky south of declination -46° contains few spectacular regions with bright nebulae in cloud complexes of the kind that can be found farther north (like the Orion and Taurus clouds). However, there are certainly some southern regions that deserve further study, like the one centred at $\alpha = 11^{\text{h}}08^{\text{m}}$, $\delta = -77^\circ$ (1950.0); see the figure.

My future plans include a search for very red and/or reddened objects around a number of nebulosities in the catalogue by means of near-infrared photography. I also expect to map in different formaldehyde lines a few regions with particularly simple geometries.

The catalogue has been published in *Astron. & Astrophys. Suppl. Series* **29**, 65 (1977).

Accurate Spectrophotometry of Early-type Spectrum Variable Stars

A Danish astronomer, Dr. Holger Pedersen from the Astronomical Institute of the Århus University, has recently used a novel instrument, ELIS, to measure the intensity (equivalent width) of the He I 4026 line in early-type stars. The accuracy is impressive and Dr. Pedersen has found several new spectrum variable stars. The observations were carried out at the ESO and CARSO observatories and are here summarized by Dr. Pedersen:

The spectrum line variations of the Ap and Bp stars have so far mostly been studied by ordinary photographic spectroscopy. With photoelectric spectroscopy it is now possible to get better equivalent-width data for individual spectral lines ("area" of a spectral line). During three observing sessions on La Silla I have used the Danish Echelle Line Intensity Spectrometer (called ELIS, see Fig. 1) to observe the strength of the He I 4026 line. The candidates for the first two sessions were B-type He-strong and He-weak stars while still hotter CNO stars were observed during the last run.

The Photometer

The measured quantity R is the ratio of flux through a 9 \AA wide slit centred on the spectral line and a $2 \times 7.5 \text{ \AA}$ wide, double continuum slit. The precise relation between the index and the equivalent width of He I λ 4026 has yet to be established. A provisional relation from the definition of the index is

$$W = 9 - 15 R$$

but this function does not take into account scattered light, the instrumental profile or a possible dependence on the rotational velocity of the star.

The bandpasses are defined by two out of twelve exit slots mounted on a wheel which may be rotated by computer command. The wheel itself may be displaced along the direction of dispersion to correct for radial velocities, slit offsets and bending. By means of observations of spectral lamps the wavelength zeropoint is kept constant to an accuracy of about $\Delta\lambda/\lambda = 10^{-5}$. A small fraction of the light which passes through the entrance slit and the order separating interference filter is directed to a reference photomultiplier instead of the grating. Measuring the ratio of the signals from these two channels, a very efficient correction for scintillation and variable cloud cover is obtained.

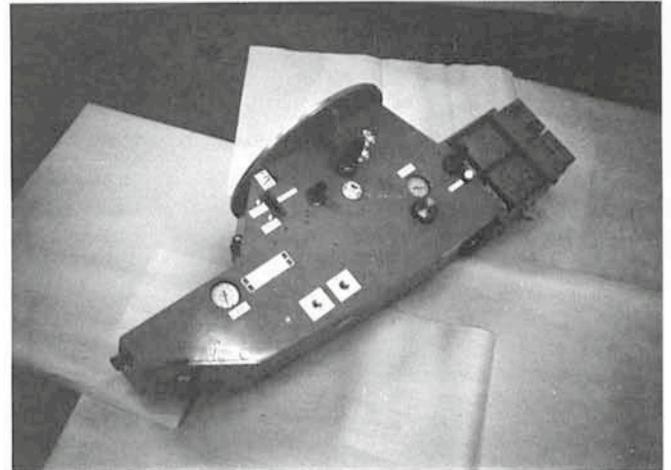


Fig. 1. — The ELIS photometer.

Optically ELIS is identical to the prototype used by Dr. P. E. Nissen and described by him in *Messenger* No. 9. The present instrument, however, is computer-controlled so that only a few operations must be done manually. ELIS has also been used successfully as a medium-resolution scanner but its main advantage is in the field of absorption-line measurements. The design of a fully-automated echelle photometer with several optical and mechanical improvements is presently being studied. With such an instrument one can measure in quick succession the strength of several spectral lines and thereby obtain more data for the analysis of the spectrum variable Ap and Bp stars.

The Observations

During the first observing run seven out of 26 stars were found to be spectrum variables. One of the most interesting